



***Mannomicrus* (Hymenoptera: Diapriidae), a new genus of myrmecophilic diapiiid, with a digital version of Masner and García's (2002) key to New World Diapriinae and an illustration of digital description and key markup using an ontology**

MATTHEW YODER

Department of Entomology, Texas A&M University, College Station, Texas, 77843, USA. E-mail: diapiiid@gmail.com

Abstract

Mannomicrus Yoder **gen. nov.** is described with the type species *Hemilexis jessei* Mann, 1914. The genus is only the second myrmecophilic member of the tribe Spilomicrini (Diapriidae: Diapriinae) known from the New World. The new genus is diagnosed versus potentially closely related genera and included in an updated on-line version of a recently published key to New World Diapriinae, which is introduced here. The digital key extends the utility of the original key with additional annotations, navigational functions, and additional images. Both the text of the key and an on-line version of the description can be "marked-up", with words contained there-in checked against an ontology of Hymenoptera morphology terms and linked where matches are found. The usage and means to produce the digital products are briefly reviewed. Both the key and a digital version of the description presented here mark the start of a new web site on diapiiid systematics available at <http://www.diapiiid.org>.

Key words: *Mannomicrus*, myrmecophilic, Diapriidae, New World, electronic key, taxon pages, ontology

Introduction

Numerous myrmecophilic diapiiids are known for the New World (*e.g.* Huggert and Masner 1983; Loíacono 1981, 1987, 2000; Loíacono *et al.* 2000; Loíacono and Margaria 2002; and for a comprehensive list of genera see Masner and García 2002). The vast majority of these genera belong to a single tribe of Diapriinae, the Diapiiini, though their association with ants has likely evolved independently in several lineages (Masner, pers. comm., Yoder, unpublished). There are several notable exceptions to the general rule that myrmecophilic species in the New World belong to the Diapiiini: 1) some species of *Coecopria*, a genus of uncertain placement (Masner and García 2002), are known to be ant parasites (Loíacono and Margaria 2002); 2) species of *Bruchopria* belong in the Spilomicrini; and 3) the enigmatic *Hemilexis jessei* (Spilomicrini) is reported to be myrmecophilic (Mann 1914). In the Old World *Spilomicrus myrmecophilus* Nixon (Nixon 1947) is the only available record for a myrmecophilic spilomicrine.

Hemilexis jessei Mann, 1914 was last treated in Johnson (1992) where it was transferred, without review, to *Entomacis* based on the synonymy by Muesebeck (1958) of *Hemilexis* Foerster with *Entomacis* Foerster. It is known only from the type series. Yoder (2004), based in part on unpublished information from Lubomir Masner, excluded *H. jessei* from *Entomacis* and left it *incertae-sedis*.

Masner and García (2002) provided a much needed key to the identification of New World Diapriinae, including several newly described genera. As new taxa are discovered, such as the one presented here, it is desirable to extend rather than re-invent Masner and García's (2002) key. Towards this end a digital reproduc-

tion of this key is presented here, which adds new functionality, color images, and textual annotations. In addition to the electronic key, this taxon description represents the first published description to be simultaneously made available as an electronic taxon-page using the mx (short for "matrix") content management system (Yoder *et al.* 2006). The application is available following links at <http://www.diapriid.org>.

Material and methods

Descriptions. All known specimens (n=11) of the type series of *Hemilexis jessei* were examined. These specimens are deposited at Harvard University (MCZC: USA, Massachusetts, Cambridge) and the Canadian National Collection of Insects and Arthropods (CNCI: Canada, Ontario, Ottawa). The type series was compared with specimens of all potentially related genera housed at CNCI and the Texas A&M University Insect Collection (TAMU: USA, Texas, College Station). Measurements for the description were taken as in Yoder (2004), and all character states recorded at 60–140x. Terminology follows Yoder (2004) and Masner and García (2002). Descriptive statements are post-fixed with '?' when observations are interpretations based on hidden or very minute characters. These observations need further confirmation via dissection and/or SEM, tasks which were presently impossible given the small type series. All images were taken with a MacroFire camera mounted on a MZ16Apo stereomicroscope and post-processed using AutoMontage™ and PhotoShop®.

Key, electronic taxon-pages, and ontology. The electronic version of Masner and García's (2002) key and the taxon home page was built using the open-source mx taxonomic content management system described in Yoder *et al.* (2006). The project's source code and a link to a wiki with further details is available at its SourceForge® homepage which can be found following hyperlinks at <http://www.diapriid.org>.

Text in the on-line couplets and description are automatically or manually linked to terms stored in the Hymenoptera Glossary (<http://hymglossary.tamu.edu>, Deans and Yoder 2006). The Hymenoptera Glossary is a simple ontology that provides definitions for and relationships among morphological terms. It is built and managed in an installation of mx. The glossary will ultimately expand into a collaborative effort with members of the Morphbank team, the International Society of Hymenopterists, and the developers of mx.

Taxonomy

Mannomicrus Yoder, *new genus*

Type species : *Hemilexis jessei* Mann, 1914.

Hemilexis jessei Mann, 1914. Original description. Illustrated. Biology.

Hemilexis jessei var. *minor* Mann, 1914.

Entomacis jessei: Johnson, 1992. Cataloged.

Entomacis jessei var. *minor*: Johnson, 1992. Cataloged.

Hemilexis jessei: Yoder, 2004. Considered as *Spilomicrini*, *incertae sedis*.

Type material: The holotype (deposited at MCZC) of *H. jessei* is in good though somewhat dirty condition, with the left antenna missing segments past the 3rd and the right antenna missing segments past the 11th.

Etymology. A combination of "Mann", in reference to the describer, and "micrus" implying relationship to other spilomicrines. Note that Mann (1914) described *H. jessei* and dedicated it to his "...small collecting companion, Master Jesse Van Law.", it is unclear as to whether Van Law or Mann collected the actual type series.

Classification. *Mannomicrus* is easily recognized as a member of the Spilomicrini by the 13 segmented antennae and characteristic venation (marginal vein relatively long, submarginal clearly separated from anterior margin of forewing). For a further diagnosis of the tribe see Masner and García (2002).

Diagnosis. Most similar to species of the genera *Spilomicrus* and *Bruchopria*, from which it differs by the characters listed in Table 1. *Mannomicrus* can be identified by modifying the key of Masner and García (2002) as follows (see also the on-line key and color images available at <http://www.diapriid.org>):

- 28 (27). Anterior scutellar pit distinctly bifoveate; basal vein in forewing often present (nebulous); frons unarmed; Nearctic and Neotropical *Spilomicrus* Westwood [male/female] (part)
- Anterior scutellar pit unifoveate, at most with very slight medial ridge and/or some irregularly spaced longitudinal carinae, or pit absent; basal vein in forewing absent or at most spectral to very slightly sclerotized; frons armed or unarmed 28a
- 28a(28). Frons with two sharp points and transverse ledge; body not completely covered with short appressed setae; basal vein in forewing absent; South America [m] (part) *Mitropria* Ogloblin
- Frons without two sharp points and transverse ledge (fig. 1, 2); body completely covered with short appressed setae; basal vein in forewing at most spectral or slightly sclerotized; Mexico [mf] *Mannomicrus* Yoder **New Genus**

TABLE 1. Characters diagnosing *Mannomicrus jessei* (Mann) from species of *Spilomicrus* and *Bruchopria*.

Character / Taxon	<i>Spilomicrus</i> spp.	<i>M. jessei</i> (Mann)	<i>Bruchopria</i> spp. <i>sensu</i> Masner and García (2002)
anterior scutellar pits	2- prominent clearly separated pits, pits infrequently with scattered carinae	1- carinate throughout, medial most carina sometimes enlarged, but never to the degree found in species of <i>Spilomicrus</i>	0- no pit present
posterodorsal pronotum	unmodified, not prominently visible in dorsal view	flat, prominently visible in dorsal view	elevated (dentate), prominently visible in dorsal view
petiole	elongate cylindrical	elongate cylindrical	short, transverse
setae of metasoma/ propodeum	varied, but usually dense and long and never uniform, dense and short	dense and short	dense and short

Description. Female (males unknown), length 2.1–3.0mm, mean=2.6.

Head. Width: 0.46–0.56mm, mean=0.54; height: 0.46–0.61mm, mean=0.66; length: 0.46–0.55mm, mean=0.52 (Fig. 3); mandible broad, bidentate, with two teeth of subequal length at apex with few scattered erect setae medially and towards base; clypeal ledge reduced, separated from clypeus by narrow groove; clypeus trapezoidal, bearing 4–5 setigerous punctures laterally, setae erect and long; supraclypeal face flat, with all but medial strip densely covered with short, appressed setae, interspersed with few scattered erect longer setae; malar sulcus absent; eye asetose; ommatidia small, surrounded by glabrous patch; dorsal head (frons and post-ocellar vertex), except for small patch surrounding ocellar triangle, densely covered with short appressed setae; posteroventral gena with thick patch of setae, these setae being slightly longer than those appressed on remainder of head; longer erect setae absent on dorsal head and gena; occipital carina complete, short and blade-like; maxillary (3? segmented) and labial (2? segmented) palps very reduced; hypostomal carina short, sharply defined.

Antenna. (Fig. 6) Scape thickening towards apex, apex with short but well-developed flanges laterally and

slight depression ventrally; pedicel reduced, not much larger than A3; A3 slightly longer than or subequal to A4; A4–A7 subequal, cylindrical; A8 broader than A7, following segments subequal; A8–A13 with MGS brush (Yoder 2004), only very slightly flattened ventrally; antennomeres densely covered throughout with short, fine, semi-appressed setae (sensilla); 1–3 erect uniporous? sensilla present along dorsal and ventral surfaces of A8–A13.



FIGURE 1–3. *Mannomicrus jessei* (Mann), female; 1- habitus, lateral; 2- habitus, dorsal; 3- head, anterior.

Mesosoma. Width: 0.50–0.65mm, mean=0.52; height: 0.48–0.63mm, mean=0.57; length: 0.85–1.17mm, mean=1.05 (Figs. 4–5, 7); all of mesosoma, except for small subcircular patch on lateral pronotum and medial strip of dorsal mesoscutum and scutellar disc, densely covered with short, appressed setae, setae of metathorax particularly dense; pro- and mesosoma without any longer semi-erect to erect setae; pronotum in dorsal view (Fig. 5) broadly visible to near axilla, area anterior to anterior-most mesoscutum unmodified, laterally sub-triangular, only slightly depressed near propleural suture; notauli absent or indicated as fine creases across mesoscutum, mesoscutum where notauli usually located bare (Fig. 5); anteromedian and parapsidal lines absent or very slightly indicated as shallow depressions; humeral and suprahumeral sulci absent; mesopleuron more or less flat, with few elongate narrow grooves in upper-posterior corner; epicnemial pit very reduced, slit like; median oblique line absent; anterior scutellar pit present, shallow, transversely elongate, with 2–4 longitudinal carinae at its base; posterior junction of axillae to scutellar disc finely carinate; scutellar disc with lateral edges irregularly carinate, lateral-most edge sharply carinate, posterior margin lined with short, irregular scrobiculae; dorsellum with medial keel and lateral keels absent; axillar depression reduced, not deeply impressed; metapleuron more or less flat, depressed slightly just above hind coxa; outer metanotal process subtriangular, glabrous; propodeum somewhat flattened, carina forming posterior margin very well-developed, sub-horizontal, in dorsal view completely obscuring nuchal area, nucha, and most of petiolar flange; median propodeal keel short (Fig. 5); all legs relatively uniform in form and as follows- coxa small; trochanter without distinct invagination near apex; femur massive, thickened all but basally, slightly flattened and glabrous ventrally, particularly near apex; tibia with narrow elongate base, widening evenly towards apex; tarsal segment one the longest, two to four subequal, short, five longer (Fig. 7); pretarsal claws very well-developed, crescent shaped, sharply pointed at apex.

Wings. (Fig. 9) Forewing submarginal vein separated from anterior margin by clear gap, marginal vein elongate, clearly longer than very short stigmal vein, remaining venation absent to spectral; forewing marginal microtrichia very short (anterior margin) to completely absent (posterior margin); hind wing with only slightly sclerotized submarginal vein, remaining venation absent, with marginal microtrichia developed similarly to forewing.

Metasoma. (Fig. 8) Petiole elongate, subcylindrical, with no prominent carinae except near petiolar flange and along ventrolateral most margin, completely densely covered with short appressed to semi-erect setae and with much longer, erect setae on lateral surface; gaster formed by 6 tergites and 5 sternites, with no short appressed setae except for small irregular patch on basoventral S2, with longer, erect setae more or less evenly spaced throughout; ovipositor tip sharp, in some specimens extruded prominently, terminalia otherwise hidden.

Color. Legs, scape, and pedicel light yellow-brown; remaining body brown; anterior and ventral pronotum lighter in some; smaller individuals lighter color overall.

Variation. Mann (1914) was probably led to describe *Hemelexis jessei* var. *minor* based on the lighter color and slightly smaller size of the individuals in question. Smaller individuals (including, but not limited to the two specimens labeled *Hemelexis jessei* var. *minor*) are generally lighter colored throughout, the pronotum more exposed in dorsal view and the setae appear narrower and slightly lighter. The observed variation is much less than seen in other diapiiid species, particularly those that are gregarious parasites, and it is clear that the specimens represent a single species.

Biology. The type series is associated with several ant specimens that Mann (1914) collected. Mann (1914) states these ants to be *Formica subcyanea* Wheeler. This identification is confirmed by a determination attached to the specimen made by T.P. Nuhn 2001, and by a subsequent determination made by myself. Mann (1914) noted that only one or two wasps were present in each colony and that they moved slowly (and freely) among the ants. Masner and García (2002) observed that many specimens of *Bruchopria* have their wings torn or completely removed (likely by ants); this was also the case of most of the specimens of *M. jessei* examined. In some individuals the ovipositor (not sheath) is extruded to a degree not typically seen in other genera of

Diapriinae, and its tip appears quite sharp. The form of the ovipositor would seem to indicate that *M. jessei* is endo- rather than ectoparasitic, though this remains to be proven.

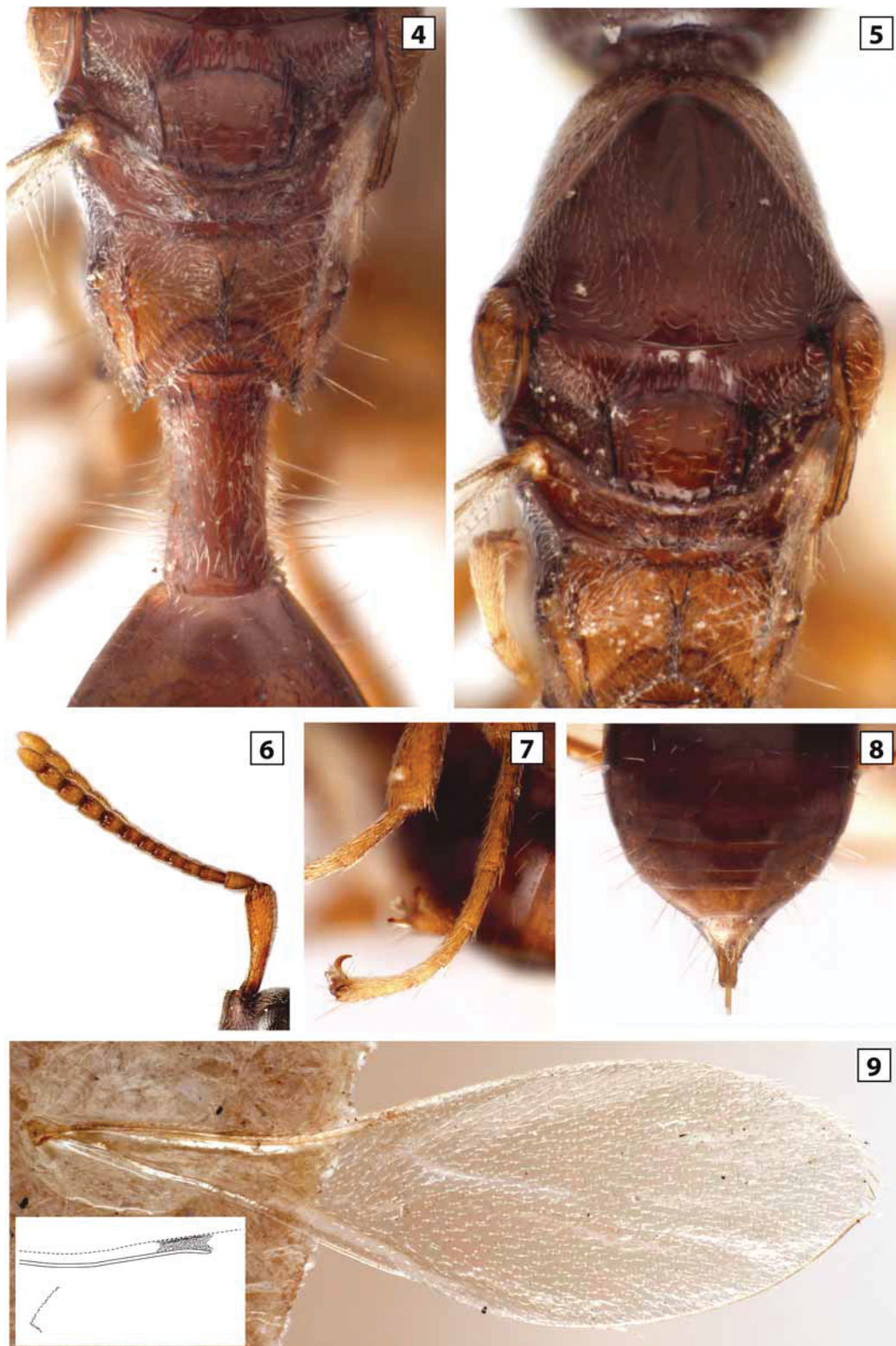


FIGURE 4–9. *Mannomicrus jessei* (Mann), female; 4- scutellum, propodeum, petiole and anterior T2, dorsal view; 5- mesosoma, dorsal view, note that the anterior scutellar pit illustrated here is considered to be unifoveate, see digital key for true bifoveate state; 6- antennal, lateral view; 7- hind tarsus, note well-developed tarsal claws; 8- posterior metasoma, dorsal view; 9- forewing, note absence of long microtrichia along margin; inset- form of submarginal (=radial) vein junction to anterior margin of forewing.

Distribution. All labels bear the same information, "Guerrero Mill. | Hidalgo, Mexico | W.M. Mann.", though some are alternately spelled "Guerrereo Mill". Mann (1914) notes the locality as "Guerrero Mill, located below Real del Monte, at the Hacienda de Velasco". Guerrero Mill, Mineral del Monte, is at 20.15667N, -98.66W, elevation 2600m, in the state of Hidalgo.

Remarks. While *Mannomicrus jessei* clearly has affinities to species of *Spilomicrus* extending the generic concept of *Spilomicrus*, a very specious genus (> 160 species), to incorporate *M. jessei* is undesirable for several reasons: 1) it would greatly weaken the differential diagnosis of *Spilomicrus* by allowing for an exception to the otherwise uniform characters of form of the anterior scutellar pit and absence of short, appressed pilosity; and 2) it would overlook differences in biology, as species of *Spilomicrus*, with the possible exception of *S. myrmecophilus*, are not known to be myrmecophilic. Based on the description of Nixon (1947) *S. myrmecophilus* shares several similarities with *M. jessei*: 1) the anterior scutellar pit is not paired, being highly reduced; 2) the pronotum is broadly visible in dorsal view; and 3) the ovipositor is long and sharply pointed. However, *S. myrmecophilus* does not exhibit short appressed setae as seen in *M. jessei*. Similar problems with the generic placement of *S. myrmecophilus* exist. Nixon (1947) notes: "I have placed this species in *Spilomicrus* Westwood for reasons of convenience. It cannot be said rightly to belong here. ...". As gross morphological convergence is frequently associated with myrmecophily, it will require further study, perhaps molecular, to determine the precise relationships of *M. jessei* and *S. myrmecophilus* to other spilomicrines. The disparate distribution of the two species (Mexico, Mauritius) suggests that similarities in morphology may be due to convergence.

The generic description provided here is relatively specific with respect to setal characteristics. We expect that additional species in this genus, if discovered, may have some variation with respect to the pilosity patterns noted here.

On-line key to New World Diapriinae

The genus *Mannomicrus* is keyed in an electronic web-accessible version of Masner and García's (2002) key (the English version only at present). The key contains the original illustrations of Masner and García (2002) and the verbatim figure references have been retained. References to new figures are highlighted in the text, as are new text annotations clarifying certain parts. Images should not be assumed to represent all possible morphological forms, as many subtle variations may occur. Determinations should always be confirmed by reference to the more extensive generic descriptions available in Masner and García (2002). The key is available at <http://www.diapriid.org>.

Discussion

This paper recognizes *Mannomicrus jessei* as only the second truly myrmecophilic member of New World Spilomicrini. The genus *Mannomicrus* is further remarkable for its distribution, as it is currently the only genus of Diapriinae restricted to Mesoamerica (Masner and García 2002). Morphologically *Mannomicrus* is most notable for the short, appressed pilosity and lack of microtrichia along the anterior margin of the forewing, both convergent adaptations found in other myrmecophilic diapriids (Masner and García 2002). These features may be overlooked in the gross examination of bulk samples, so careful examination of additional material will be necessary to identify further specimens should they exist.

The on-line bifurcating key and taxon page were created in an installation of mx. The mx project seeks to provide a wide range of utilities to practicing systematists, one such utility being the creation and management of keys. The interface to mx is completely web based and allows for multiple projects each with multiple

users, allowing for collaborations between researchers anywhere in the world. Construction of bifurcating keys in mx is straightforward. At minimum the user fills out either side of a couplet, clicks once to save the data then clicks a button on a given side to add couplets below. The process is continued until the key is complete. New couplets can be inserted or deleted at any point wherein only one side of the present couplet can be presently followed. Couplets can be figured using images stored in mx (provided by the user) or Morphbank (<http://www.morphbank.net>). The functionality for using either image type is identical. Each figure can be uniquely annotated. Whole keys (including references to figures) may be duplicated, allowing for sequential updates while retaining original copies.

The electronic key, in addition to being easy to navigate, provides the end-user with several features not available in paper keys: at each couplet the user is shown their decision history (prior couplets), and remaining possible outcomes. Both of these lists contain links, so the user can jump back to a prior couplet or forward to one of the endpoints. Public accessibility of a given key is accomplished by selecting an "is public" option. Because the system is inherently dichotomous, it does not overcome the various problems addressed by interactive keys (see Dallwitz *et al.* 2005 for an overview), but it is well suited for extension and archiving of historically important dichotomous keys. However, users interested in multi-entry key development should note that mx also provides a multi-entry key engine and matrix manager.

Both the text of the key and the taxonomic description are linkable to a collaboratively built glossary of terms used in Hymenoptera morphology (also built in mx). This linkage greatly extends the usefulness of the text, as definitions can be applied to each matching word. However, some caution is needed when interpreting definitions in this manner. Definitions that are provided in the Hymenoptera glossary may not be those that the author intends. While this is a potential problem, it is also a means to highlight existing problems with, and encourage the adoption of, a shared terminology. The linking functionality is perhaps of most use to those actively writing descriptions and couplets, as their text can be iteratively proofed against a "standard".

It is hoped that new genera for the New World (a minority of which remain to be treated for Diapriinae) will be added to the key as they are published, and that world-wide taxa will ultimately be treated. Because of its digital nature, the on-line key can rapidly be improved with images and textual clarification. To this end, the author welcomes contributions, clarifications, and suggestions for improving the key.

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